Mapping vegetation in the summit of La Palma (Canary Islands) combining remote sensing, supervised classification and phenological patterns

García-Alvarado, Juan José[1], Bello-Rodríguez, Víctor[1], Palomares Ángel[2], González-Mancebo, Juana María[1] & del Arco, Marcelino José[1]

1 Plant Conservation and Biogeography Research Group (PLANTCAB) Departamento de Botánica, Ecología y Fisiología Vegetal.

Universidad de La Laguna, Avda. Francisco Sánchez s/n, 38200 Apdo. 456. La Laguna (Tenerife), Islas Canarias, España.

2 Caldera de Taburiente National Park. El Paso (La Palma) 38750, Islas Canarias, España

Corresponding author: jjgarciaalvarado@gmail.com

Introduction

The summit area of La Palma and its surrounding forest are ecosystems of remarkable ecological importance, with a high percentage of endemic species and where significant conservation efforts have been carried out in recent decades. However, obtaining more accurate vegetation maps and improve vegetation monitoring in this challenging and complex terrain is necessary (Padalia *et al.* 2023). This can be difficult to achieve using traditional field methods alone.

Remote sensing techniques offer powerful tools to classify and analyze vegetation over large areas, especially in remote or inaccessible regions. This study employs supervised machine-learning classification of medium-resolution satellite imagery to map the vegetation communities in La Palma's summit region.

The **objectives** of this research are to:

- ☐ Develop an accurate supervised classification model for the considered vegetation types focusing on their spectral signatures
- ☐ Generate a detailed vegetation map of the study area
- ☐ Assess the topographical affinities of key plant communities

This work aims to provide valuable data for ecological research, conservation planning, and monitoring of potential vegetation changes in this sensitive alpine ecosystem. The results will contribute to our understanding of La Palma's unique summit ecosystem and even support evidence-based management of this protected area.

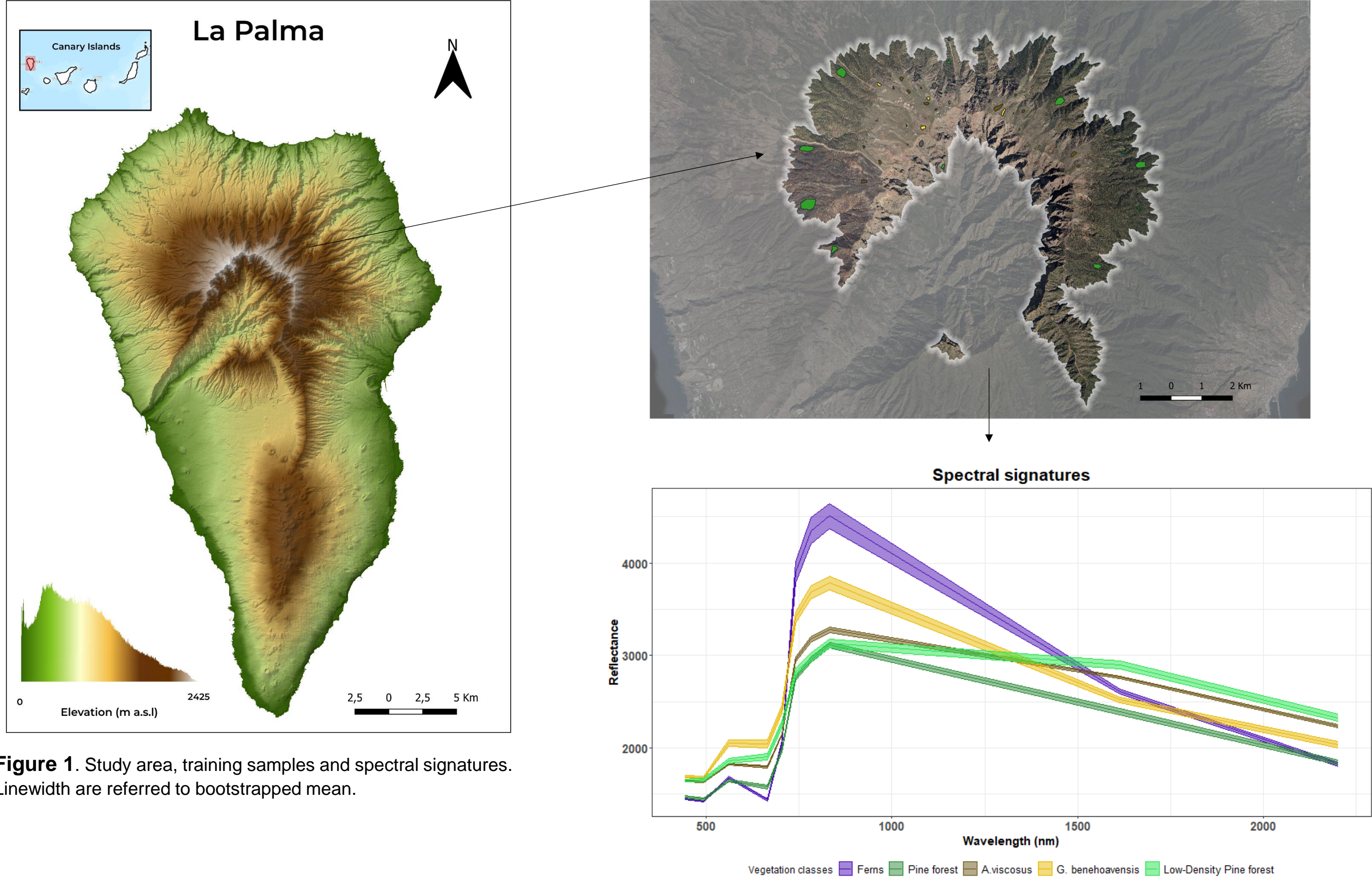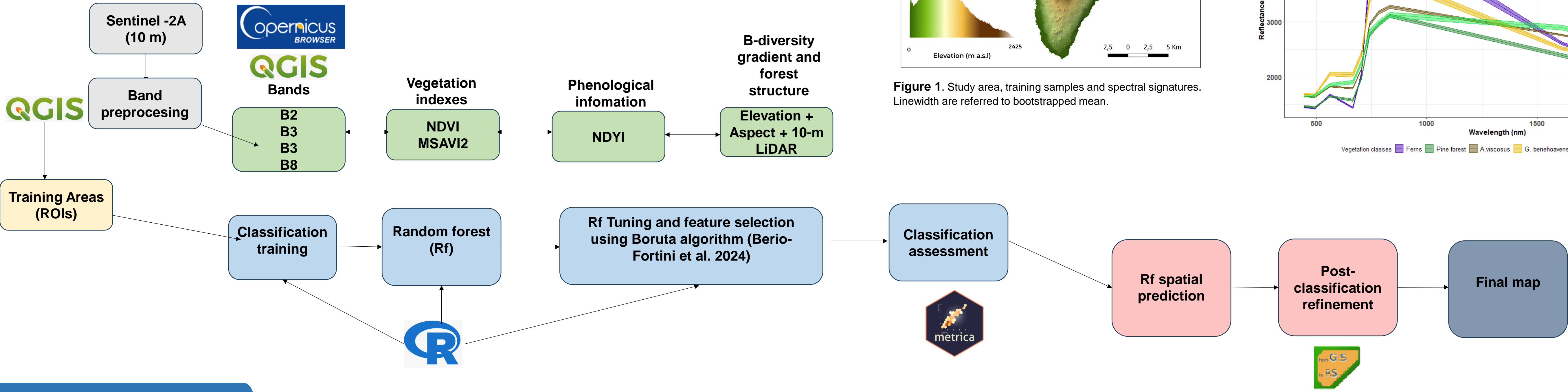**Figure 1**. Study area, training samples and spectral signatures. Linewidth are referred to bootstrapped mean.

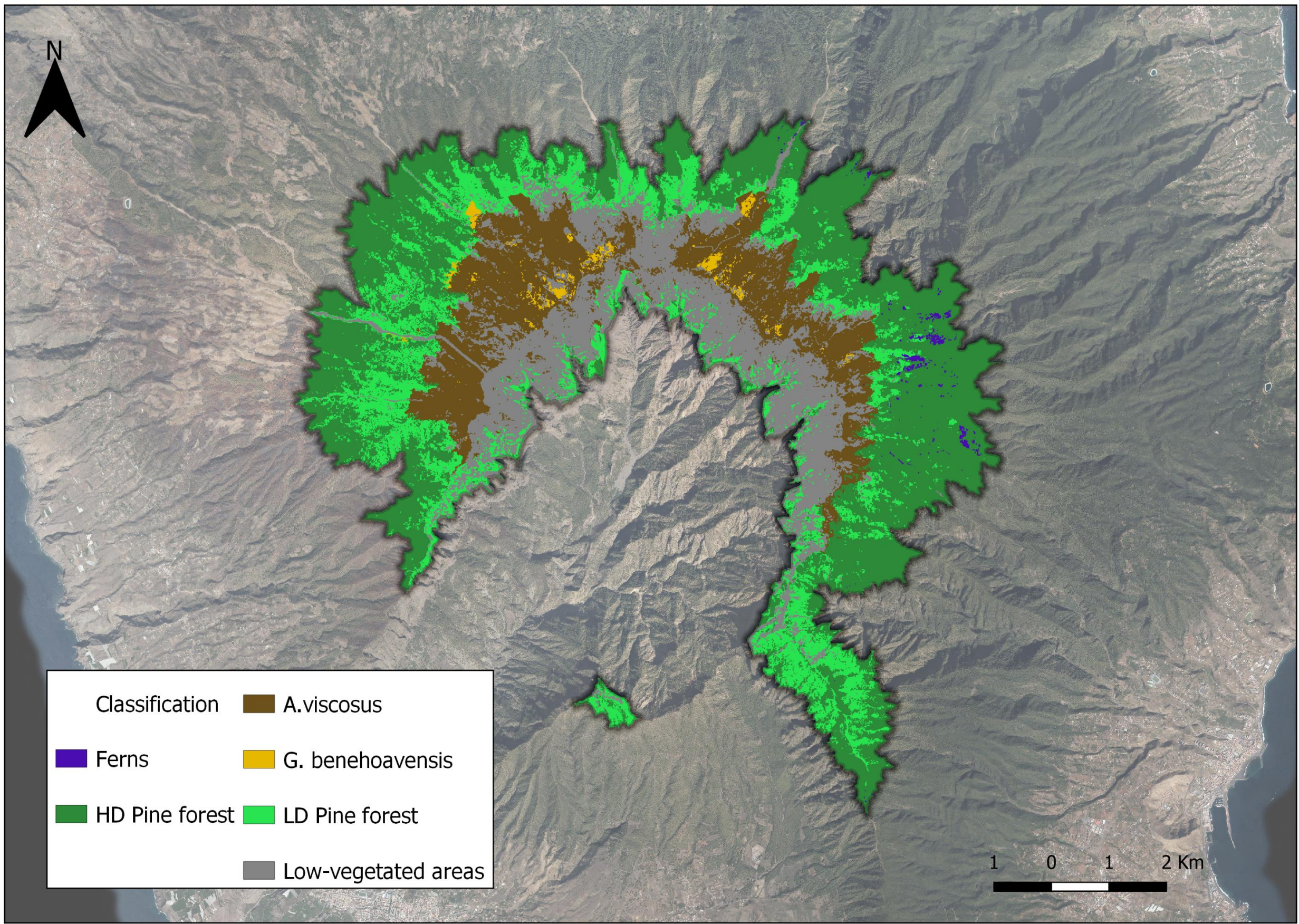## Material and methods

Results

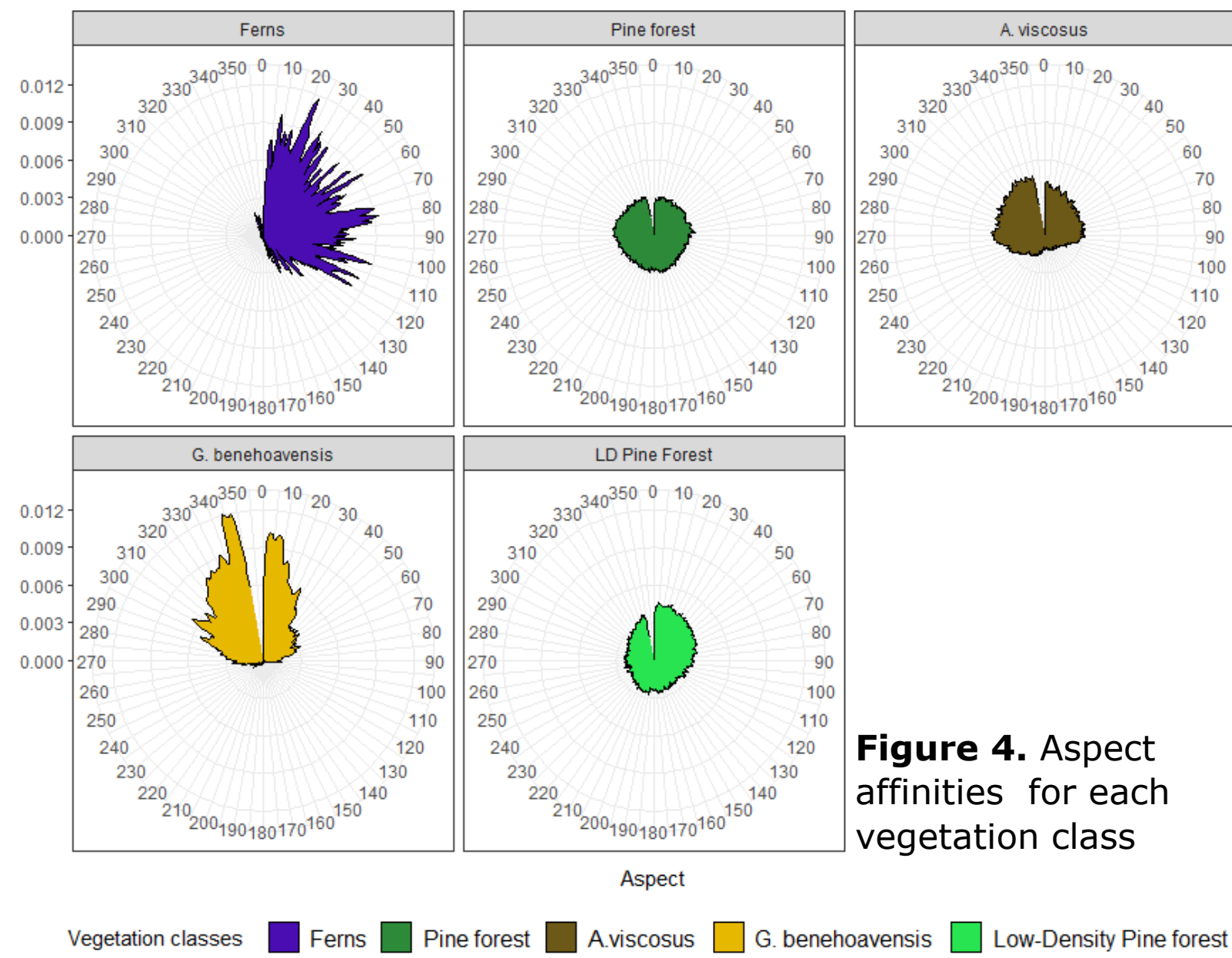**Figure 3.** Final vegetation map for La Palma summit.

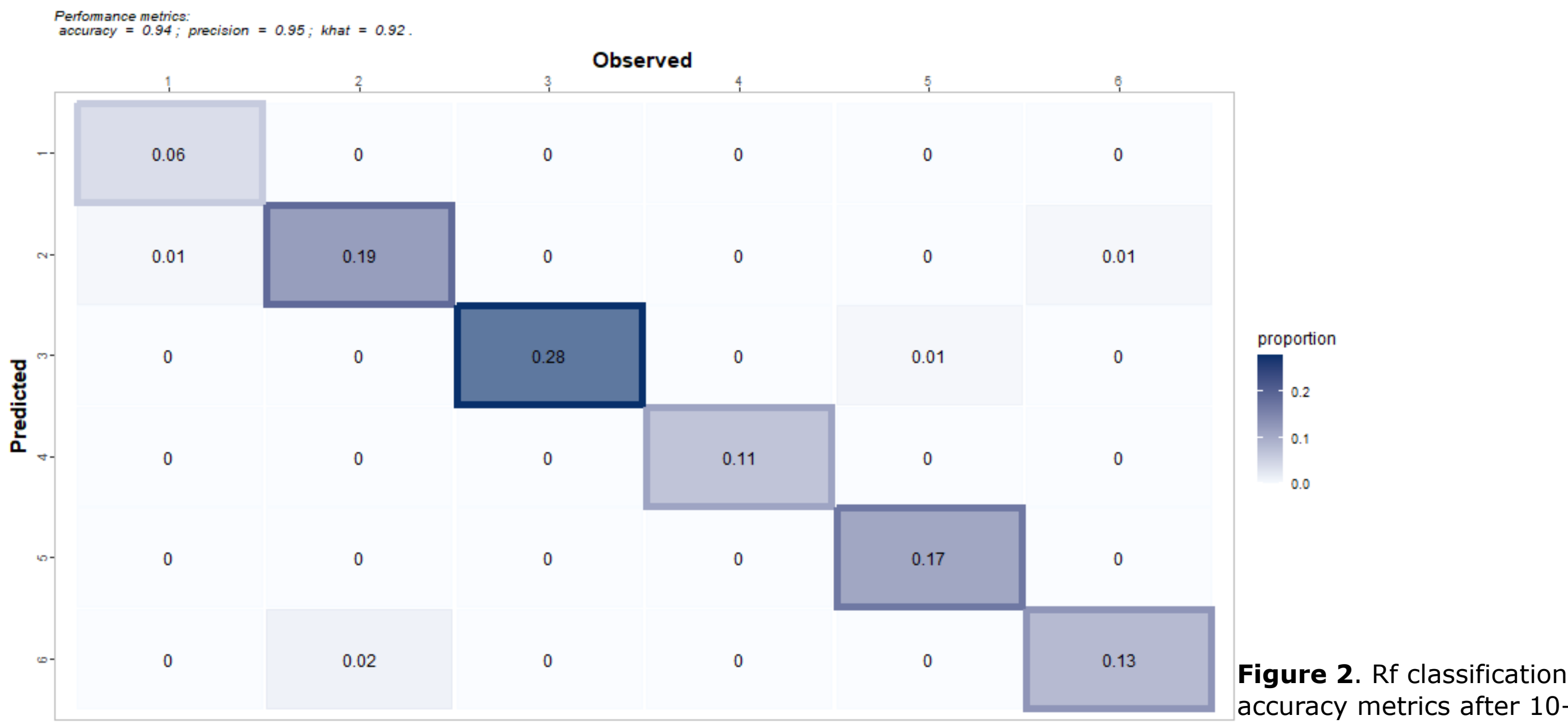**Figure 4.** Aspect affinities for each vegetation class

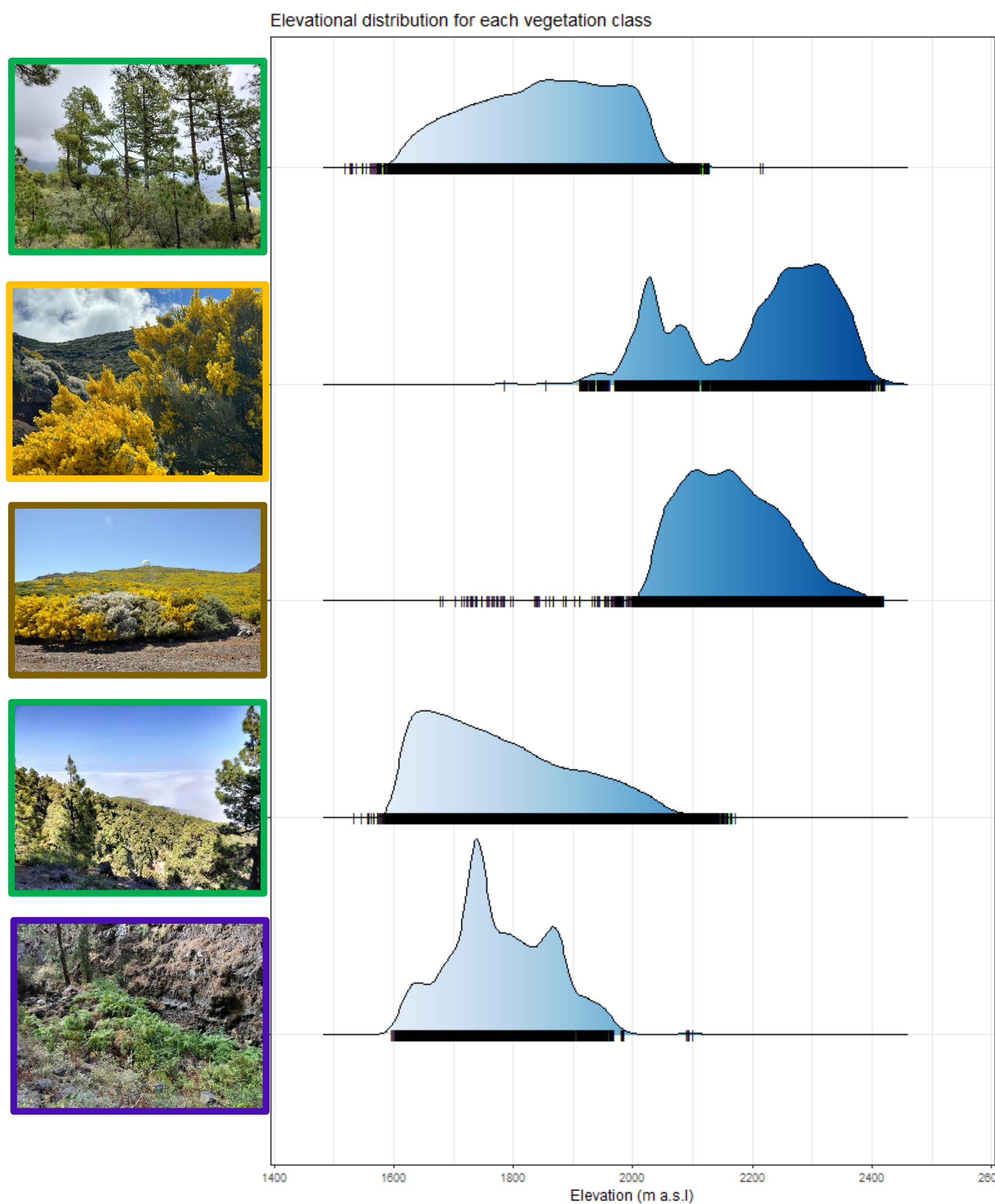**Figure 2**. Rf classification accuracy metrics after 10-fold Cross-Validation.

Figure 5. Elevational distribution for each vegetation class.

Conclusions

- Supervised classification machine learning algorithms, such as Random forest, allowed to differentiate 5 vegetation types in a narrow and topographically complex area. Moreover, we obtained a high classification accuracy metrics for each class.

- *Genista benehoavensis* patches are distinguishable from *Adenocarpus viscosus*, the most widespread plant in the summit sector, provided their differences in spectral response through phenology allow it. This current spatial coverage is illustrative of a species once considered highly endangered and its recovery.

- The amount of reflectance emitted by the soil, the differences in aspect and the elevational range allow distinguishing the summit and thermic pine forests from the more humid and typical stands.

- The greenness during certain phases of its life cycle as well as canopy gaps in the pine forest allow distinguishing some patches of bracken (*Pteridium aquilinum*) in the understory.

- This study provides a framework for applying these methods to both short- and long-term monitoring of La Palma's summit vegetation and particular species of interest like *G. benehoavensis*, which exhibit distinguishable spectral responses. This is of great importance in the context of climate change, as shifts in distribution and phenology of species are expected. Additionally, the methods can be applied to other areas of topographically complex islands such as the Canaries.

References

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